

APPENDIX B

SELECTING AN UNINTERRUPTIBLE POWER SUPPLY (UPS): AN EXAMPLE

The following example illustrates the use of the selection process described in this handbook. Please note that no one example can serve as the model or template for every possible case. Each case in which an UPS is being selected for a specific facility is unique and the specifics of the process will vary. All figures are for purposes of the example and should not be considered indicative of actual costs.

John Public, who will be the facility manager for the new Eastville plant, now in planning, of ABC, Inc., is selecting the UPS to be installed in the plant. With the aid of his engineering staff, Mr. Public has gone through each of the steps of the process. Following is a summary of how each step was accomplished.

1. *Determine the need for UPS.* Mr. Public knows that many of the electrical loads are critical and even a lapse in power of 5 seconds could result in damage to very expensive processing equipment and could lead to injuries to operators. He is also aware of governmental regulations that require that lighting for evacuations and for other functions must be available in the event of a loss of power. Clearly, an UPS is needed.

2. *Determine the purpose of UPS.* Based on discussions with his engineers and production personnel, the following purposes were identified for the UPS.

- Power lighting for evacuation, security, and facilitate orderly shutdown.
- Continue heating, ventilation, and air-conditioning (HVAC) functions for selected equipment to facilitate orderly shutdown. Shutdown of the entire plant could take as much as 2-3 hours.
- Provide power to critical processing functions and controls until orderly shutdown can be completed.
- Continue fire protection in the event of a loss of power.
- Provide communications (paging within plant).

3. *Determine the power requirements.* Mr. Public's engineers have calculated the total power requirements for the UPS to be 1000 kVA. But Mr. Public is concerned about growth. He decides to add a 12.5 percent "cushion" to allow for growth. The engineers endorse this approach to cover overvoltages and other anomalies. So the total power required is 1250 kVA. At a power factor of .80, this is equivalent to 1000 kilowatt (kW).

4. *Select the type of UPS.* A diesel generator is selected for the UPS. Diesels start quickly, are reliable, can provide the needed power for as long as necessary, and are easy to maintain. The UPS should be on-line. Based on discussions with his staff, Mr. Public knows that an on-line system is the best choice for providing the maximum possible protection for critical loads. The efficiency of the diesel generator is about 93 percent. Mr. Public was advised by his staff that a high efficiency means less heat will be generated by the UPS. The result will be increased battery life, higher reliability, and decreased cooling requirements.

5. *Is safety of selected UPS acceptable?* The diesel generator will be located outside of the main plant. Personnel will be isolated from the noise of the diesel. Separate HVAC will ensure that exhaust and battery fumes (the battery is vented) are properly vented and that the battery will not be operated at temperatures above 25°C. The engine is a proven-design, used for many years in similar applications, and has a good safety record.

6. *Is selected UPS availability acceptable?* The UPS can start, come up to speed, and take up the load within 3 seconds. The reliability of the UPS in previous applications is equivalent to about a 200-hour mean time between maintenance (MTBM). Preventive maintenance procedures were developed using a reliability-centered maintenance (RCM) approach and allows maintenance personnel to keep the unit in “like-new” condition with a minimum of expense. The average time to repair a failure is less than 5 hours, so the availability is .9756.

7. *Is selected UPS maintainable?* As already stated, the diesel generator has a proven record of low maintenance and has excellent preventive maintenance procedures. Since ABC, Inc., operates and maintains its own fleet of diesel-powered trucks, and will operate and maintain many alternating current (AC) motors in the plant, Mr. Public feels that maintenance can be done internally. Major repairs, such as overhauls, will be outsourced.

8. *Is cost of UPS acceptable?* The price of the diesel generator is \$60,000 and construction of a separate building will cost \$250,000. So the total acquisition cost is \$310,000. Operating and maintenance costs are estimated by Mr. Public’s staff to be \$30,000 over 15 years. This estimate is based on an MTBM of 200 hours, fuel consumption of 70 gallons per hour, labor costs of \$25 per hour, and a conservative forecast of 20 operating hours per year. All figures are in constant calendar year 1998 dollars. Of the total budget for constructing and outfitting the new plant, \$350,000 was allocated for the UPS, therefore, the total acquisition cost is acceptable. Mr. Public knows that similar plants within ABC, Inc., spent about \$25,000 last year on all maintenance. He estimates that maintenance for the new plant, excluding the UPS, will take about \$22,500 per year. That would mean the total cost per year with the UPS operating and maintenance costs included would be about \$24,500. Disposal costs are considered negligible, since some of the costs can be recouped through sale of the UPS for parts and scrap. Mr. Public is concerned about the estimate because it only has \$500 of “wiggle room.” He decides to look at an alternate UPS. Back to step 4.